

Geospatial Impact Evaluation of Highways

Evidence from Iraq and Morocco

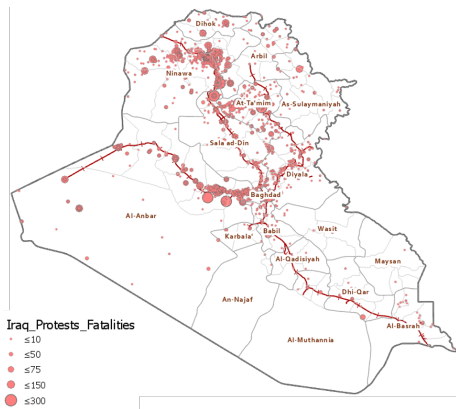
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- **Context and Challenges to Ground-Based Data Collection** - What are the advantages of using nighttime lights to measure impact of highways in Iraq and Morocco?
- **Project Interventions** - What are some approaches to measure impact of highway projects using nighttime lights?

Context and Challenges to Ground-Based Data Collection

Why use **nighttime lights** to measure **impact** near the Iraq and Morocco road corridors?

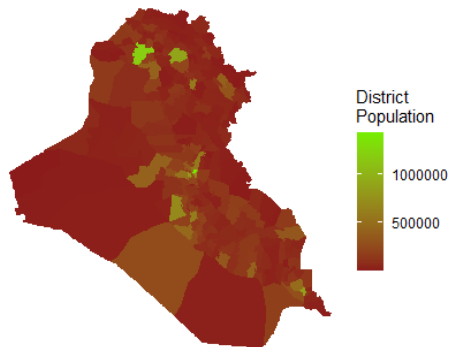


Source: Armed Conflict Location and Event Data (ACLED)

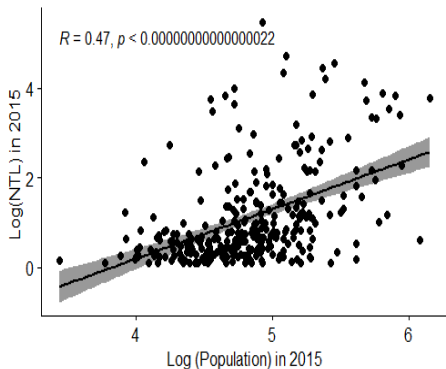
- **Fragile Conflict Zone** limits our ability to work with other counterparts on the ground
- **Lack of Availability of Important Data** limits the time-period of analysis. For instance, the latest Living Standard and Measurement (LSMS) Survey in Iraq was conducted in 2012
- **Availability of Satellite Imagery** offers a potential to conduct effective and speedy analyses.
- **Geospatial Impact Evaluation (GIE)**

Correlation between Nighttime Lights (NTL) and District Population (Iraq)

A positive and significant correlation b/w NTL and Population



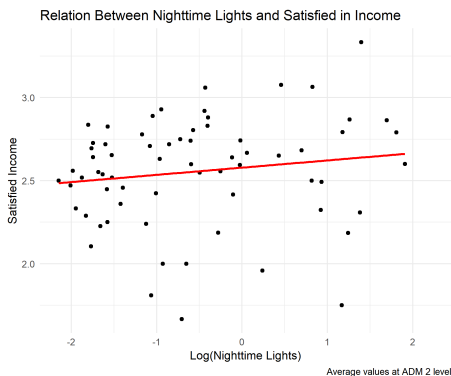
Source: LandScan 2015



Source: Average Nighttime Lights Data from Earth Engine

Correlation between Nighttime Lights (NTL) and select economic variables

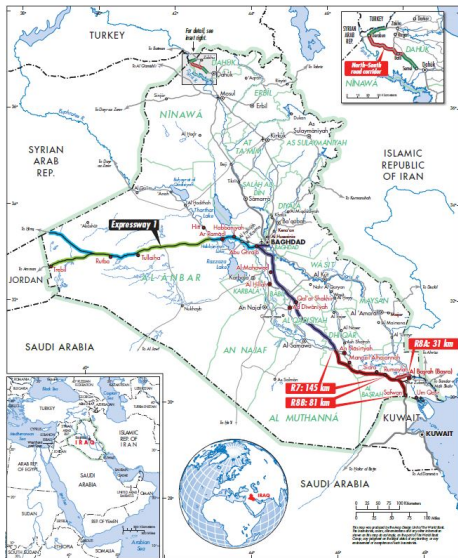
Across a majority of LSMS survey locations in Iraq (left), income and average NTL are positively correlated (right)



Source: Living Standards Measurement Survey(LSMS)

Project Interventions: Evidence From Iraq

Project Description

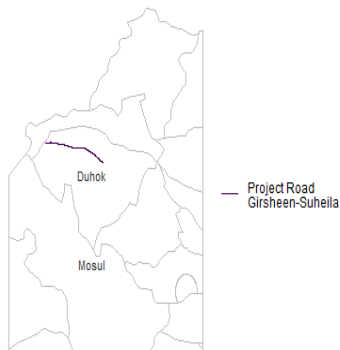


- **Sample:** 257km segment in the south-east of Iraq (R7/R8) and 23km segment in the North (b/w Girsheen, Suheila, and Derabun)
- **Model:** Panel framework with month and pixel-level fixed effects
- **Intervention Unit** All 750m square pixels that fall within 20km of the two road segments b/w Jan 2016 - April 2020

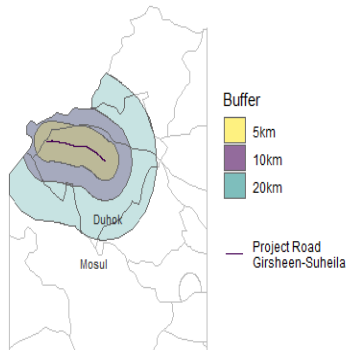
Project Evaluation Sample - Girsheen-Suheila Expressway (23km)

Transforming the data to create a monthly grid-level (750m) panel from 2012 - 2020

Identify Road Segment

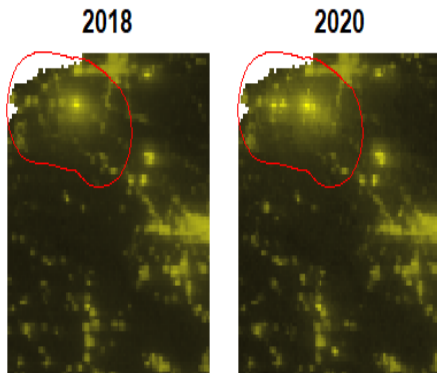


Create Buffers



Change in Girsheen - Suheila Expressway

Girsheen-Suheila Expressway opened to the public in early 2020



10km Area around
Girsheen-Suheila

NTL percent increase is highest within 10km buffer

The following results are from the **event study** conducted for the newly constructed Girsheen - Suheila Expressway

	Within the 5km buffer	
	Log(Mean NTL) (1)	Log(Mean NTL) (2)
2012	-1.584*** (0.014)	-0.903*** (0.023)
2013	-1.511*** (0.013)	-0.835*** (0.022)
2014	-1.399*** (0.013)	-0.725*** (0.022)
2015	-1.404*** (0.013)	-0.734*** (0.022)
2016	-1.473*** (0.013)	-0.798*** (0.022)
2017	-1.076*** (0.013)	-0.729*** (0.016)
2018	-0.432*** (0.013)	-0.422*** (0.013)
2020	0.105*** (0.018)	0.094*** (0.018)
ndvi		0.00002*** (0.00000)
liberation from ISIS		0.665*** (0.018)
Observations	49,955	49,955
R ²	0.508	0.521
Adjusted R ²	0.502	0.515

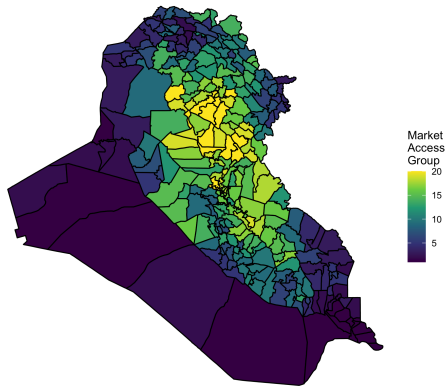
	Within the 10km buffer	
	Log(Mean NTL) (1)	Log(Mean NTL) (2)
2012	-1.051*** (0.007)	-0.532*** (0.012)
2013	-0.966*** (0.007)	-0.453*** (0.012)
2014	-0.878*** (0.007)	-0.368*** (0.012)
2015	-0.871*** (0.007)	-0.366*** (0.012)
2016	-0.934*** (0.007)	-0.424*** (0.012)
2017	-0.633*** (0.007)	-0.366*** (0.008)
2018	-0.281*** (0.007)	-0.270*** (0.007)
2020	0.134*** (0.009)	0.121*** (0.009)
ndvi		0.00002*** (0.00000)
liberation from ISIS		0.500*** (0.009)
Observations	122,511	122,511
R ²	0.538	0.548
Adjusted R ²	0.533	0.543

	Within the 20km buffer	
	Log(Mean NTL) (1)	Log(Mean NTL) (2)
2012	-0.671*** (0.004)	-0.280*** (0.007)
2013	-0.580*** (0.004)	-0.193*** (0.006)
2014	-0.511*** (0.004)	-0.127*** (0.006)
2015	-0.501*** (0.004)	-0.119*** (0.006)
2016	-0.558*** (0.004)	-0.172*** (0.006)
2017	-0.305*** (0.004)	-0.104*** (0.005)
2018	-0.172*** (0.004)	-0.166*** (0.004)
2020	0.118*** (0.005)	0.108*** (0.005)
ndvi		0.00001*** (0.00000)
liberation from ISIS		0.378*** (0.005)
Observations	303,610	303,608
R ²	0.650	0.656
Adjusted R ²	0.646	0.652

*p<0.1; **p<0.05; ***p<0.01

How can we measure the **economy-wide** impact of improved/newly constructed highways in Iraq?

Market Access (theta = 3.8)
Excluding Areas within 100km



- **Market Access:** Using the shortest distance between districts and road length as a proxy for market size, we estimate the real distribution effects of the new/improved highways across Iraq

Evidence From Morocco

Project Description

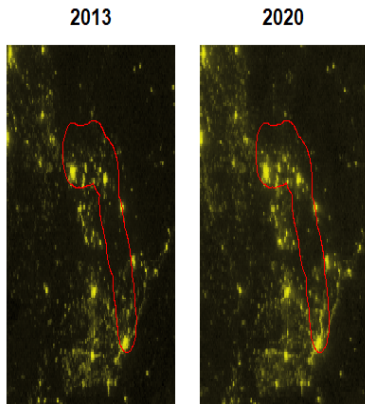
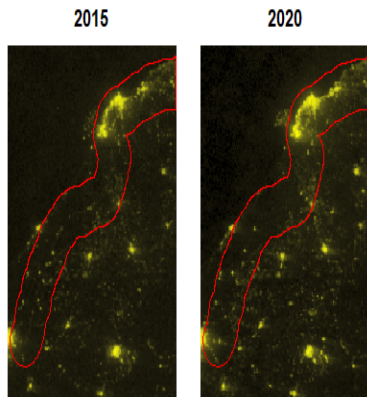



- **Sample:** 95km segment running West to East (Khouribga-Benimellal) and 143km segment running North to South (Eljadida-Safi)
- **Model:** Panel framework with month and pixel-level fixed effects with an emphasis on the impact on the exits along these highways
- **Intervention Unit** All 750m square pixels that fall within 20km of the two road segments b/w Jan 2012 and March 2020

Is there a change in NTL after the opening of the Highways?

The Eljadida - Safi Expressway opened in August 2016: 38% increase.

Khouribga - Beni-Mellal opened in May 2014: 24% increase.



 10km Area Around Eljadida

 10km Area Around Khouribga

NTL percent increase is highest within the 5km buffer

<i>Khouribga - Benimellal Expressway</i>			
	Log(Mean NTL)		
	(5km)	(10km)	(20km)
road_improvement_khouribga	0.188*** (0.001)	0.171*** (0.001)	0.156*** (0.0004)
Month and Pixel FE	Yes	Yes	Yes
Observations	178,092	423,211	1,005,890
R ²	0.150	0.148	0.144
Adjusted R ²	0.141	0.139	0.135
F Statistic	31,027.740*** (df = 1; 176255)	72,897.930*** (df = 1; 418847)	167,521.900*** (df = 1; 995519)
Note:	*p<0.1; **p<0.05; ***p<0.01		

<i>Eljadida - Safi Expressway</i>			
	Log(Mean NTL)		
	(5km)	(10km)	(20km)
road_improvement_eljadida	0.213*** (0.001)	0.193*** (0.0005)	0.180*** (0.0003)
Month and Pixel FE	Yes	Yes	Yes
Observations	242,597	541,066	1,044,884
R ²	0.241	0.249	0.259
Adjusted R ²	0.233	0.241	0.251
F Statistic	76,364.050*** (df = 1; 240095)	177,373.500*** (df = 1; 535487)	361,180.900*** (df = 1; 1034111)
Note:	*p<0.1; **p<0.05; ***p<0.01		

Removing urban agglomerates near the Highway

Eljadida East, Eljadida South and Safi are urban centers along the expressway. Removing these agglomerates gives us a less biased estimate

	<i>Within the 5km buffer</i>			
	Log (Mean NTL)			
	(Entire Road)	(w/o Eljadida East)	(w/o Eljadida East + South)	(w/o Eljadida East + South + Safi)
road_improvement	0.212*** (0.001)	0.170*** (0.001)	0.150*** (0.001)	0.129*** (0.001)
Month and Pixel FE	Yes	Yes	Yes	Yes
Observations	243,082	202,924	183,039	122,220
R ²	0.240	0.255	0.281	0.237
Adjusted R ²	0.232	0.247	0.274	0.229
F Statistic	76,132.300*** (df = 1; 240575)	68,751.130*** (df = 1; 200831)	70,897.880*** (df = 1; 181151)	37,584.940*** (df = 1; 120959)

Note:

*p<0.1; **p<0.05; ***p<0.01

In Summary

- GIE approach is adapted in **data scarce and conflict affected settings**.
- **Positive and significant association** between highways construction and NTL even after controlling for confounding factors and omitted variables.
- **Rigorous, quick and effective** solution to urgent demands from policymakers
- The **potential for replication** in various settings offers significant external validity benefits